



Linking Earth Observation Systems and Applications: Systems and Projects of the German Remote Sensing Data Center Environment and Security

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German Aerospace Center – DLR
German Remote Sensing Data Center - DFD

*Earth Observation Business Network Meeting
Vancouver May 11th – 12th, 2010*



DLR

Deutsches Zentrum
für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft



The German Earth Observation Programme

- **Largest participant in European EO programmes**

ESA/EOEP, GMES and EUMETSAT programmes

- **Scientific and technical mission preparation**

TerraSAR-X-line, Tandem-L, HRWS

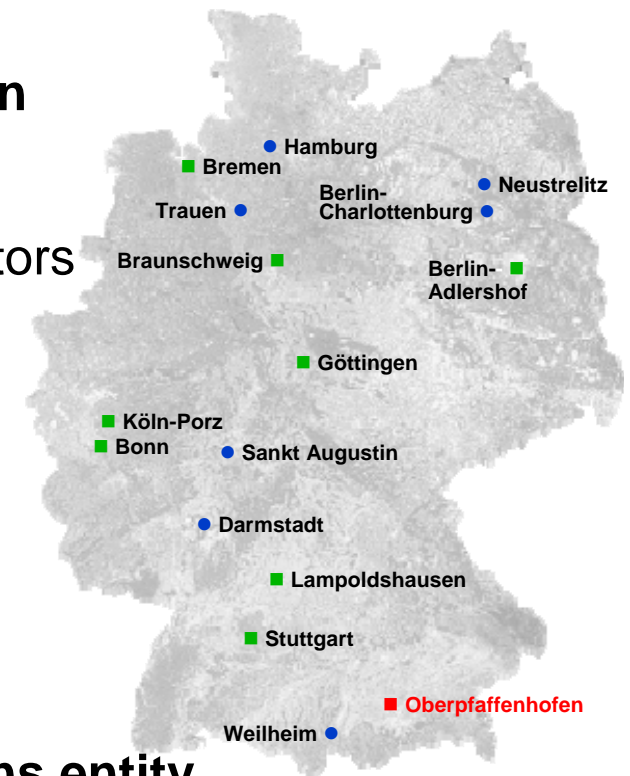
MERLIN/ lidar, EnMAP/hyperpectral, IR detectors

- **Supporting commercial exploitation**

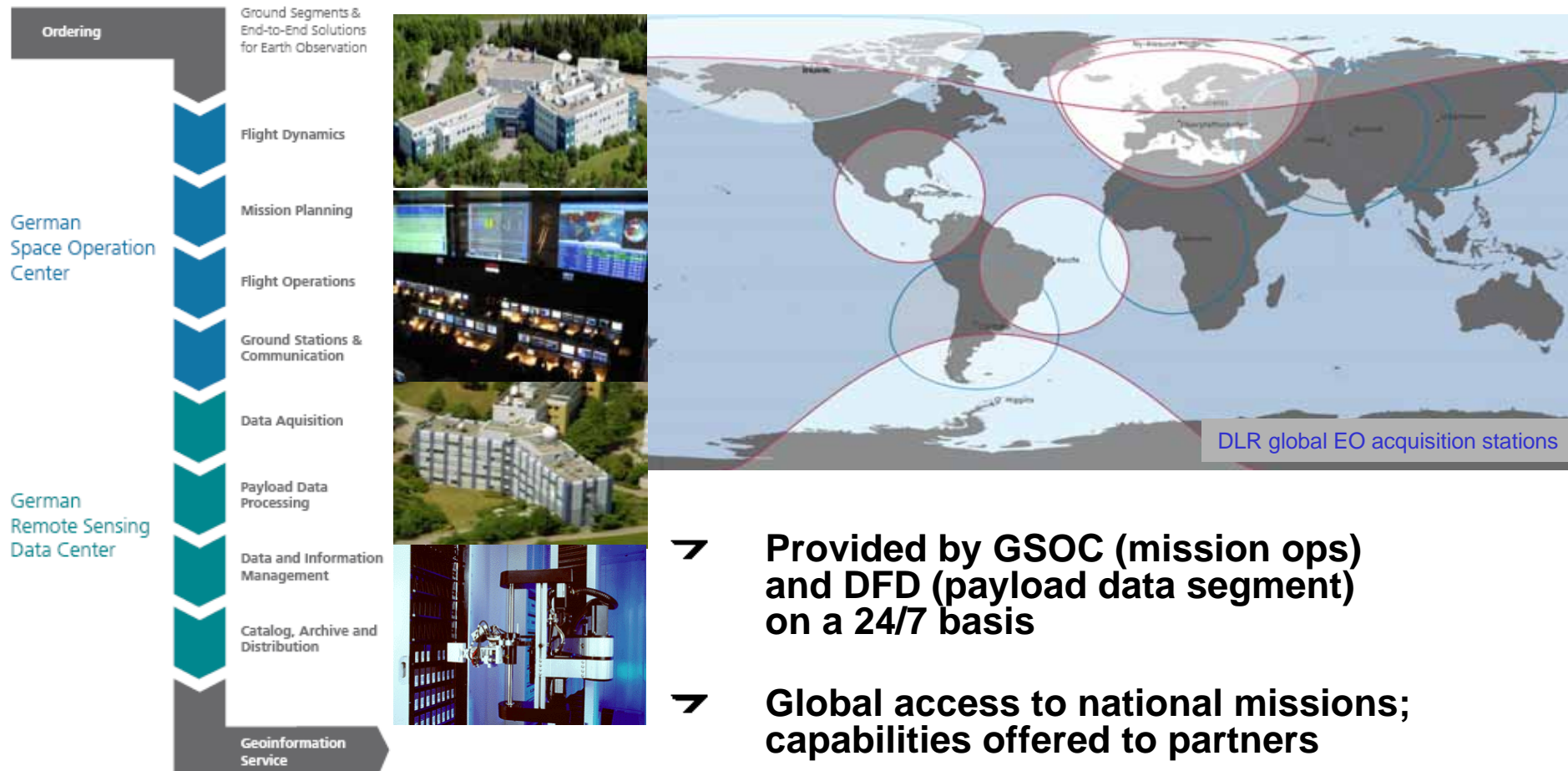
- **Contributions to international programmes**

- **Complementary national EO programmes**

- **Represented by DLR –
as space agency and as R&D and operations entity**



DLR operational Earth Observation Support



- **Provided by GSOC (mission ops) and DFD (payload data segment) on a 24/7 basis**
- **Global access to national missions; capabilities offered to partners**
- **Multi-Mission/Sensor capability; End-to-end chain**



DLR-DFD



German Remote Sensing Data Center (DFD)

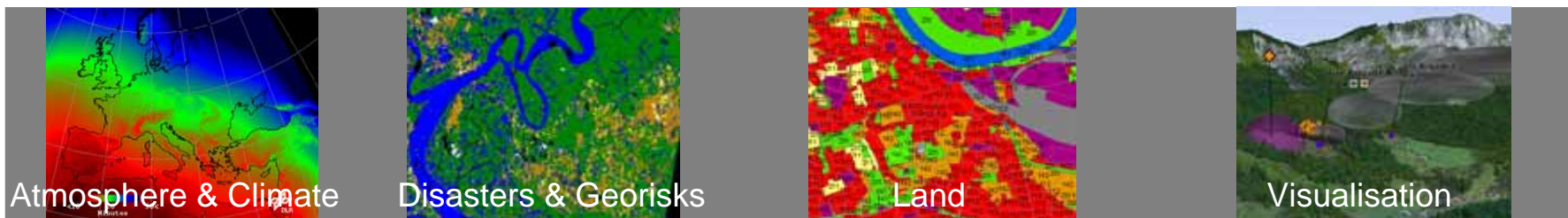
2 sites (Oberpfaffenhofen, Neustrelitz)

7 departments, ca. 200 DLR-employees

Ground Segment: EO Payload Data Management



Applications & Services



Zentrum für satellitengestützte Kriseninformation
– Notfallkartierung & Katastrophenmonitoring –
ein Service des DFD



GeoVisualisierungszentrum
ein Service des DFD



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in der Helmholtz-Gemeinschaft

Deutsches Fernerkundungsdatenzentrum

German Remote Sensing Data Center – Missions

Public & Science EO Missions

1986ff	NOAA / AVHRR
1984 ff	Landsat-5
1989-92	Aktivny
1991 ff	Meteosat / MSG
1991-00	ERS-1
1992-94	APEX / MAGIOS
1992-98	OKEAN
1992-98	JERS
1995 ff	ERS-2
1996-04	IRS-P3 /MOS
1996-98	MOMS / Priroda
1999-03	Landsat-7
1995-99	CORONAS-I
2001-05	CORONAS-I
2000-09	TUB-,MarocSAT
2000 ff	Champ
2001 ff	BIRD
2001 ff	Terra / Aqua
2002 ff	Grace 1/2
2002 ff	Envisat
2006 ff	ALOS
2007 ff	METOP
2009	ACE
2012 ff	Sentinel-1/2/3

NOAA
ESA/USGS
AIP, IZMIRAN
EUMETSAT
ESA
AIP, IZMIRAN
NPO Planeta
JAXA / ESA
ESA
DLR, ISRO
DLR, Russia
ESA
IZMIRAN, AIP
IZMIRAN, AIP
TU Berlin
national, GFZ
DLR
NASA/ESA
national, GFZ / JPL
ESA / national
JAXA / ESA
EUMETSAT
NOAA DLR
ESA

National & PPP Missions

1994	SIR-C/X-SAR
2000	SRTM
2006 ff	TerraSAR-X
2008 ff	Rapid Eye 1 ..5
2010 ff	TanDEM-X
2014 ff	EnMAP
2014ff	MERLIN

NASA & DLR
DLR/companies
DLR / InfoTerra
Rapid Eye AG**
DLR / InfoTerra
DLR
DLR/CNES

Support for commercial partners

1996-04	IRS-IC
1997-05	IRS-1D
2004 ff	IRS-P6 Resourcesat
2003 ff	Ikonos
2004-08	OrbView-2
2006 ff	IRS-P5 Cartosat
2009ff	GeoEye-1
2009ff	CartoSat-2
2010	WorldView-1
2010	WorldView-2

ISRO / EuroMap
ISRO / EuroMap
ISRO / EuroMap
GeoEye / EUSI
GeoEye
ISRO/ EuroMap
GeoEye/ eGEOS/ EuroMap
ISRO / EuroMap
DigitalGlobe/EUSI
DigitalGlobe/EUSI

** only science support

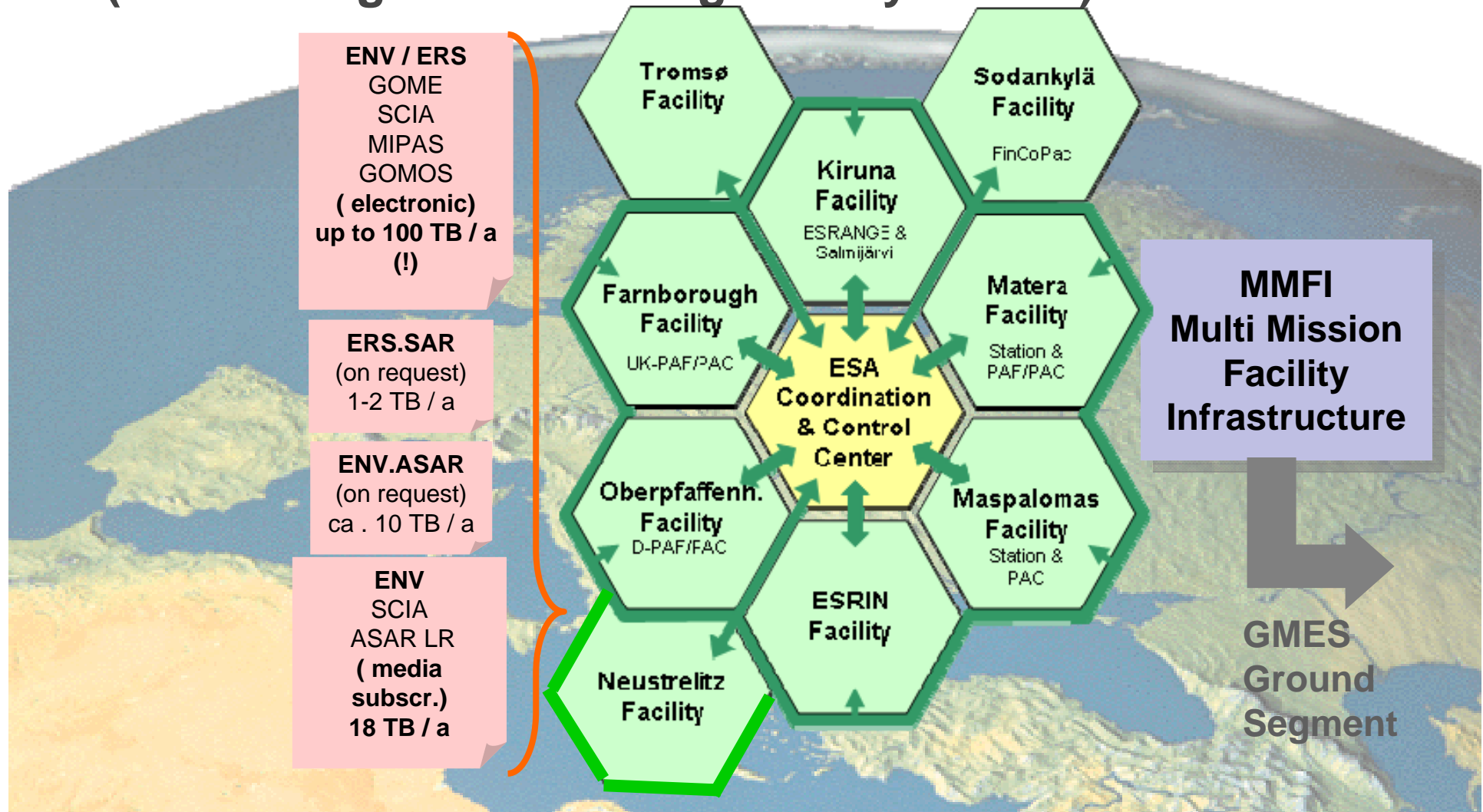
* launch dates

black: mission completed
or no more G/S activities

red: in operation

blue: in preparation

DFD as ESA D-PAF/PAC (Processing and Archiving Facility/Center)... since 1991



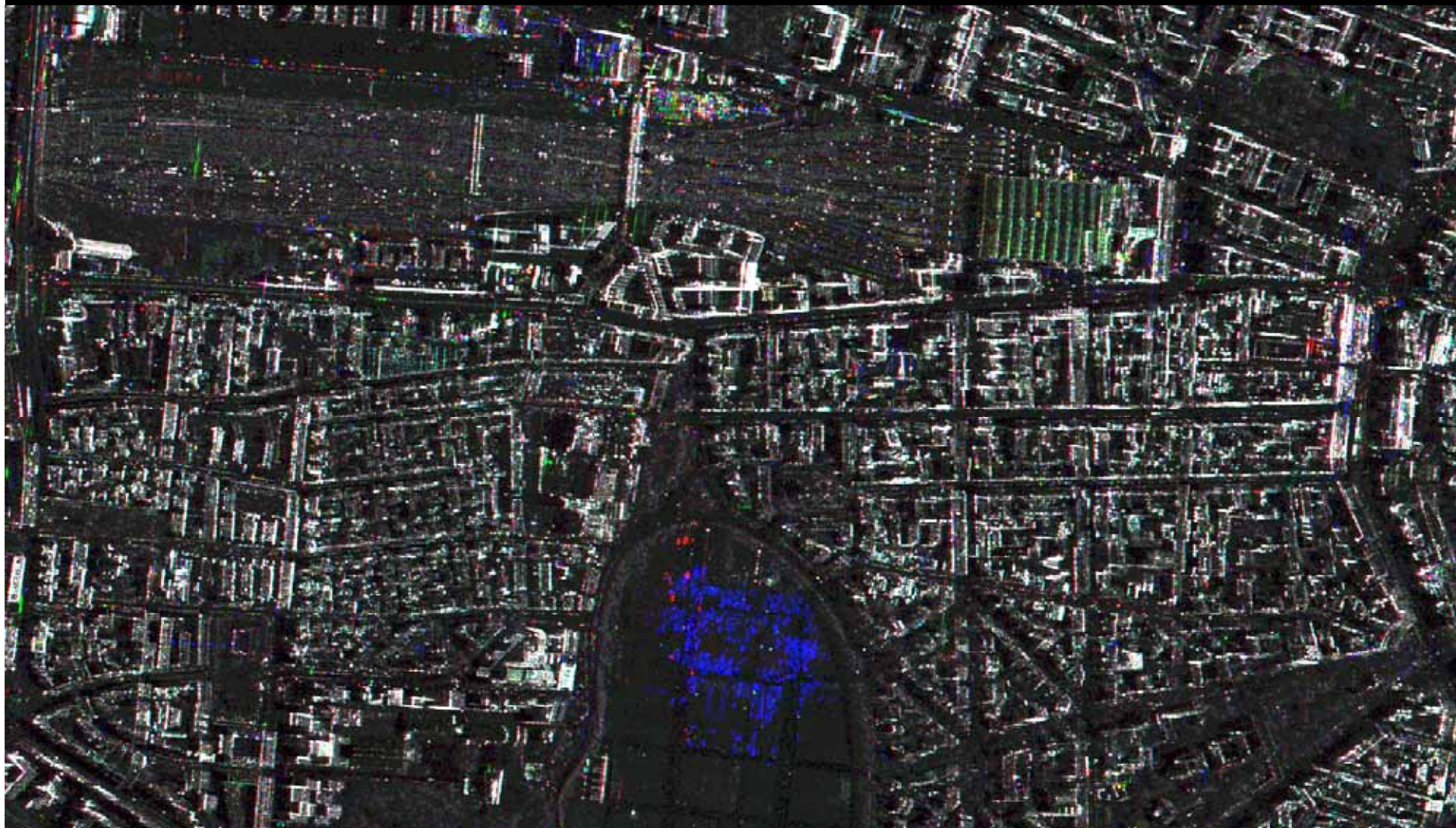
TerraSAR-X Satellite

- Launched June 15th 2007
- PPP with Astrium/InfoTerra
- Ground segment and science by DLR
- Commercialisation by InfoTerra

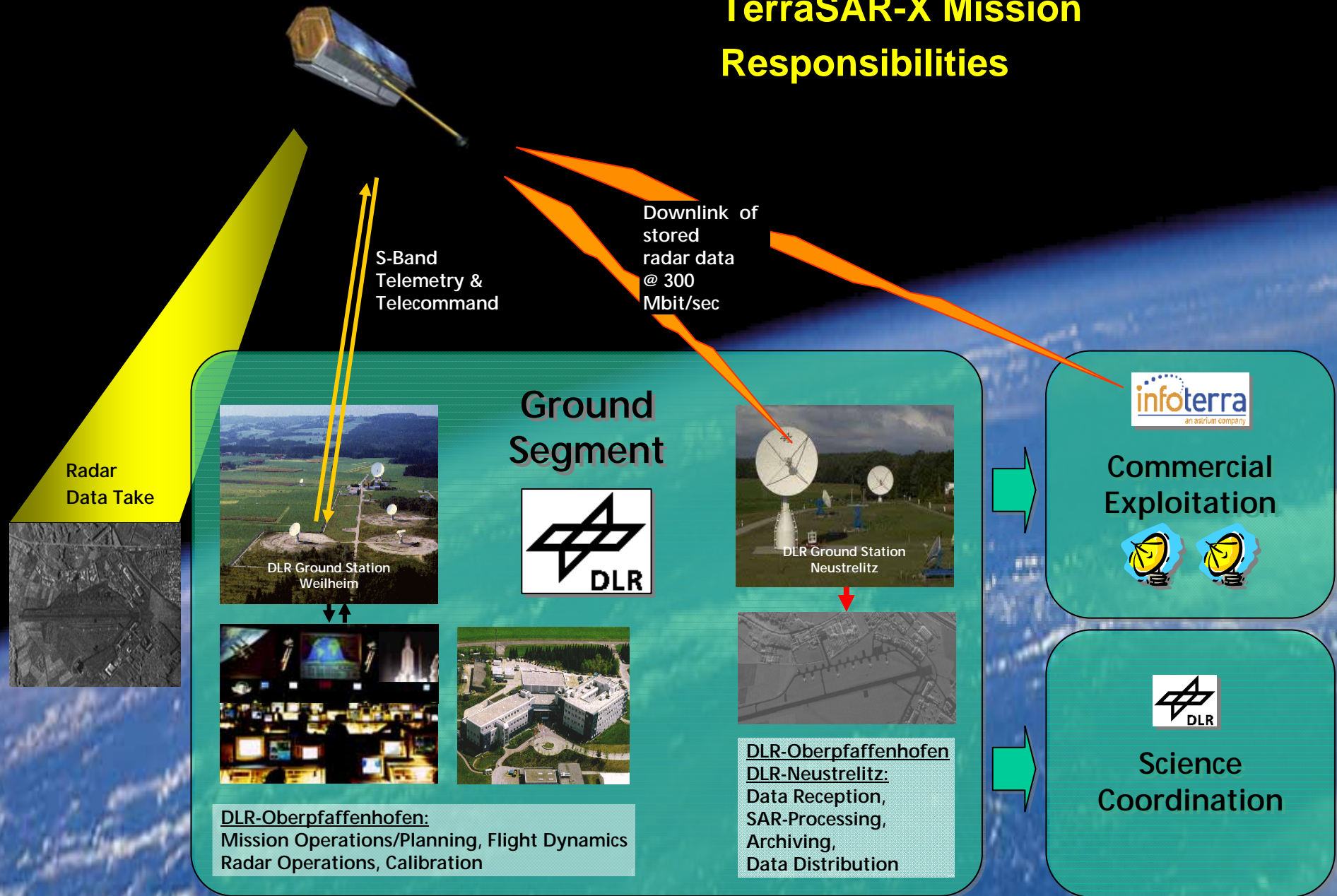
TERRASAR



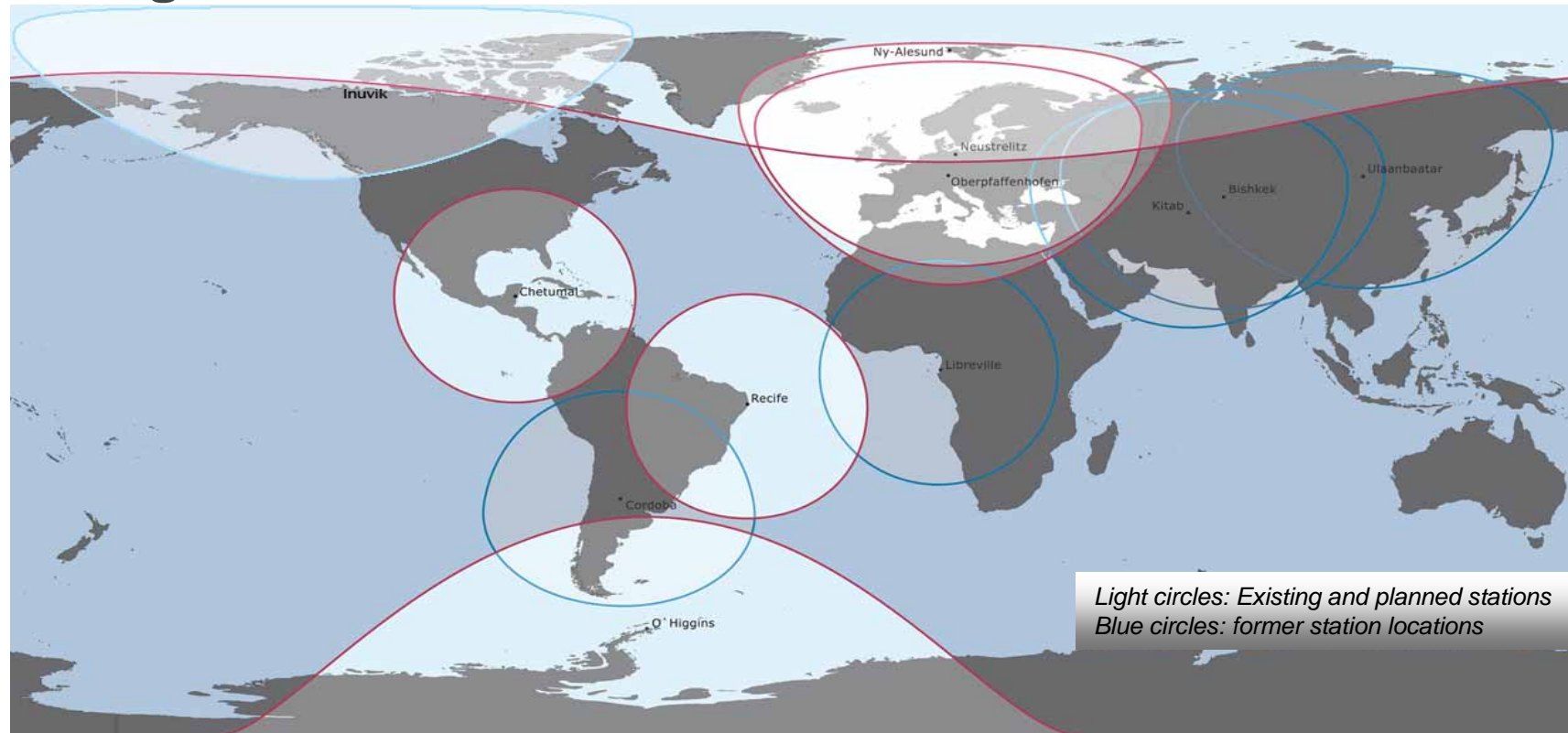
TerraSAR-X: Change Detection: Oktoberfest Munich



TerraSAR-X Mission Responsibilities



The global station network of DFD



Permanent

Neustrelitz (Germany)
Oberpfaffenhofen (Germany)

3 LSX-band 7.3 m, LS-band 4.0 m, VHF
X-band 3.6 m, L-band 2.4 m, L-band 4.0 m
X-band (5,6 m) on behalf of European Space Imaging
LSX-band 9.0 m
LSX-band 9.0 m
LSX-band 13.0 m
X-band 4.0 m
L-band 0.9 m

Transportable Mobile

O'Higgins (Antarctic)
Chetumal (Mexico)
Inuvik (Canada)
Ny Ålesund (with GFZ, Spitzbergen)
Recife (Brazil)



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DLR Neustrelitz (NSG)

53.3° N 13.1° O

Operations aspects

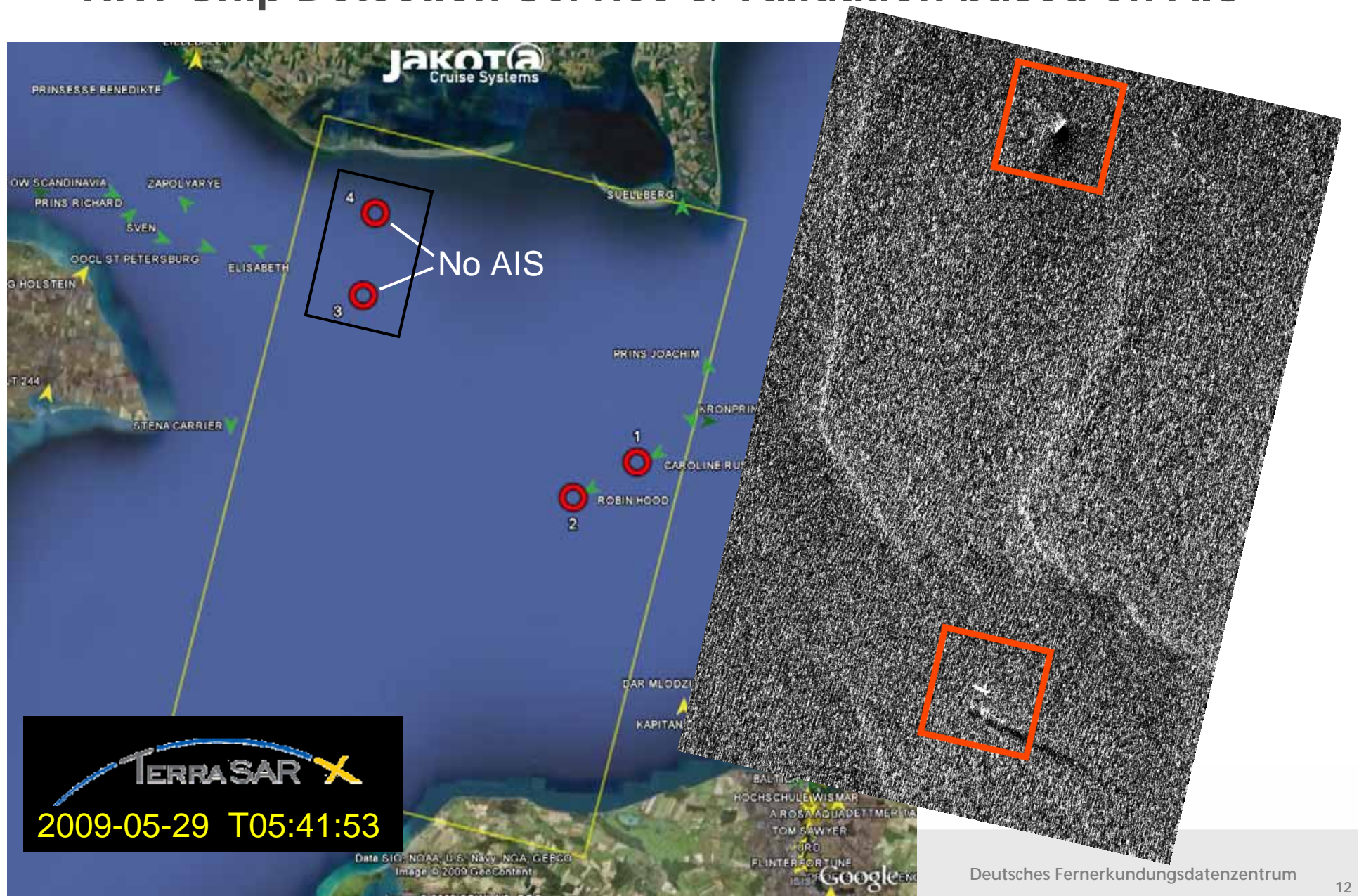
- Three S- and X-band downlink antennas (one with S-band uplink)
- 24 h Operator Support on demand

Application focus

- Near Real Time Satellite Applications Center
 - Maritime/ Ionosphere/ Solar
- European Land Coverage

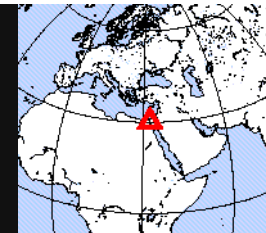


NRT Ship Detection Service & Validation based on AIS

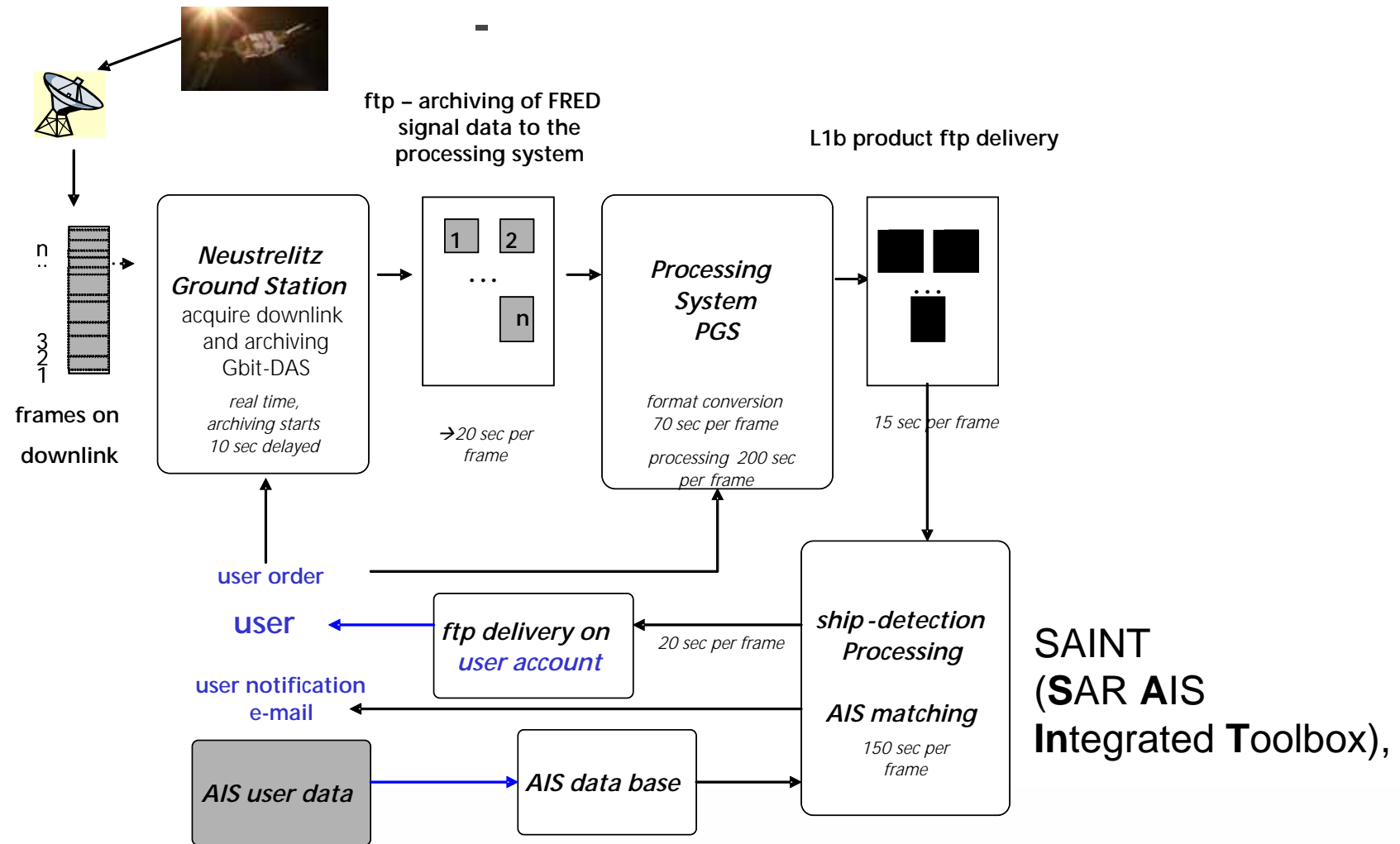


TSX-Spotlight: Suez-Canal

February 11, 2008



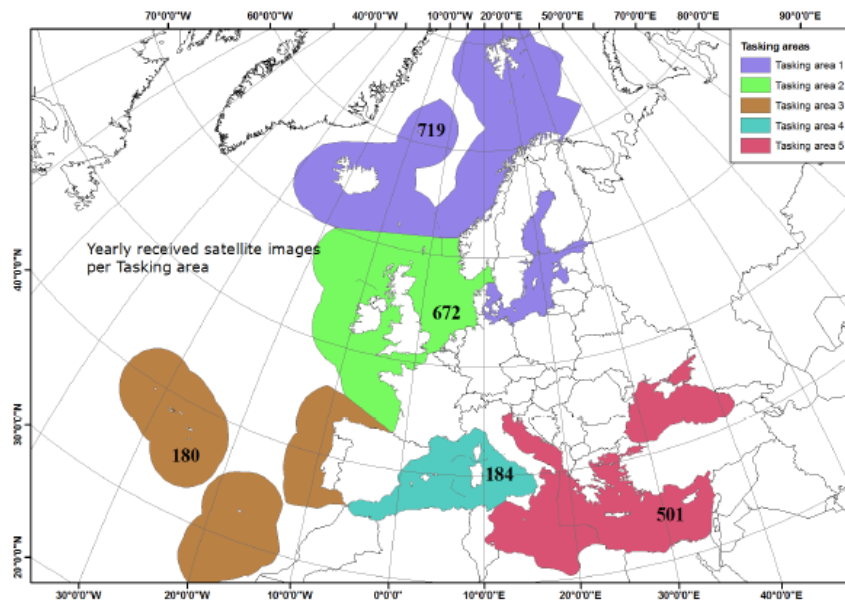
Ship Detection – Near Real Time Scenario



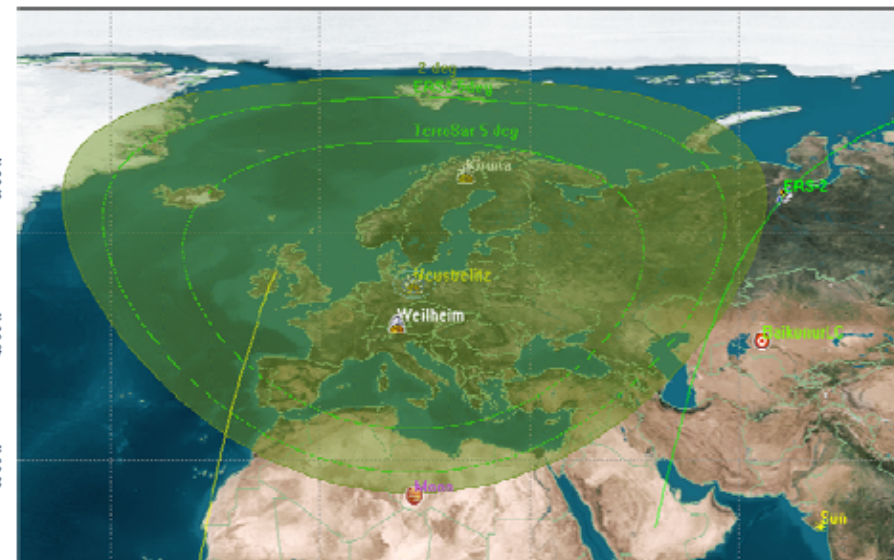


Neustrelitz as Central European Station for European Near Real Time Services

- European coverage (land and coastal areas)
- Multimission ground segment capability
- Connected to high data rate networks
- GMES interfaces



CleanSeaNet Priority Areas (by EMSA)



DFD-Neustrelitz 5 deg visibility

Supporting European MR optical Coverage

QL mosaic. CC and radiometry do not correspond to the final coverage.

Coverage #2

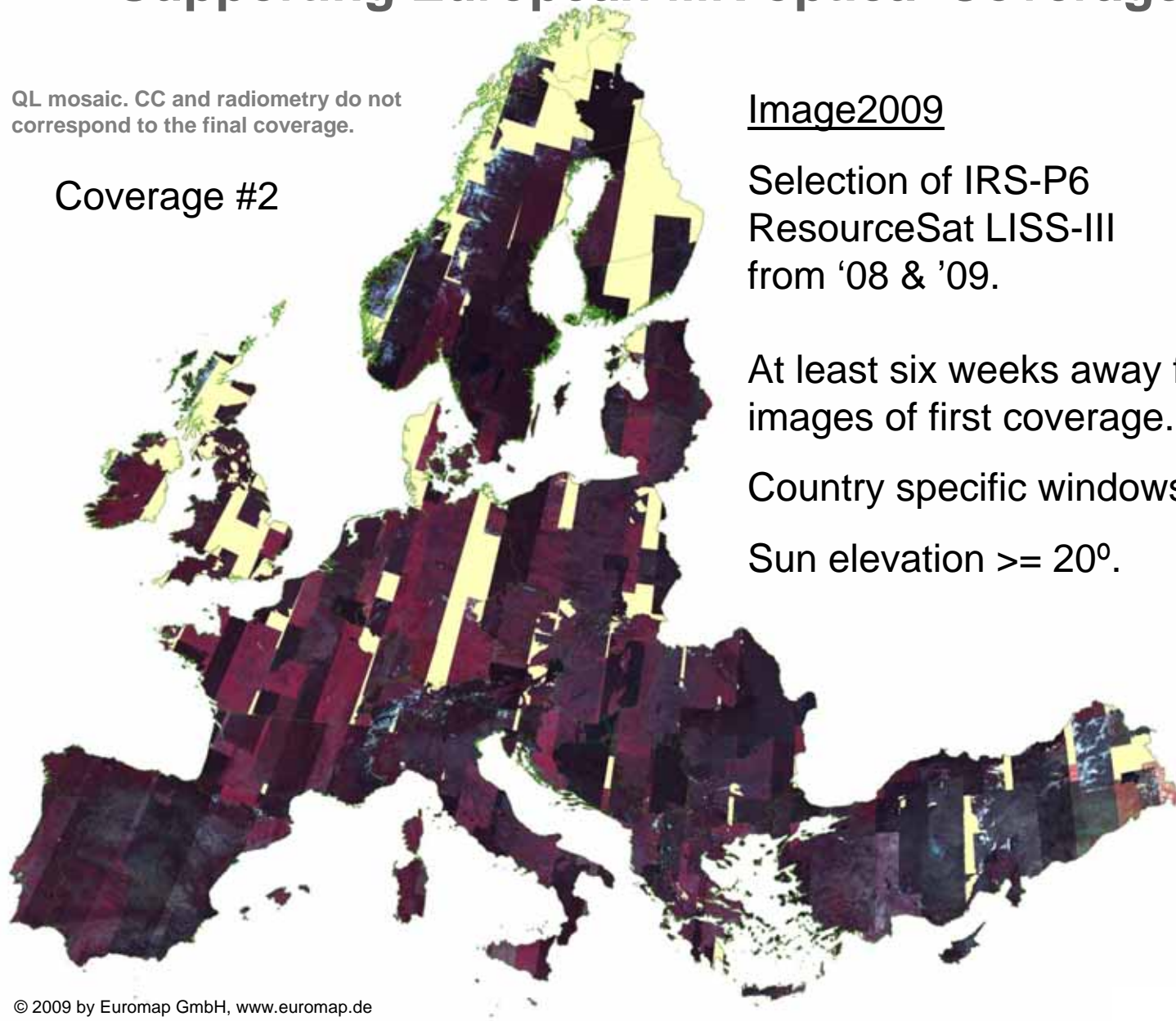


Image2009

Selection of IRS-P6
ResourceSat LISS-III
from '08 & '09.

At least six weeks away from
images of first coverage.

Country specific windows.

Sun elevation $\geq 20^\circ$.

User



Part of



Data funded by

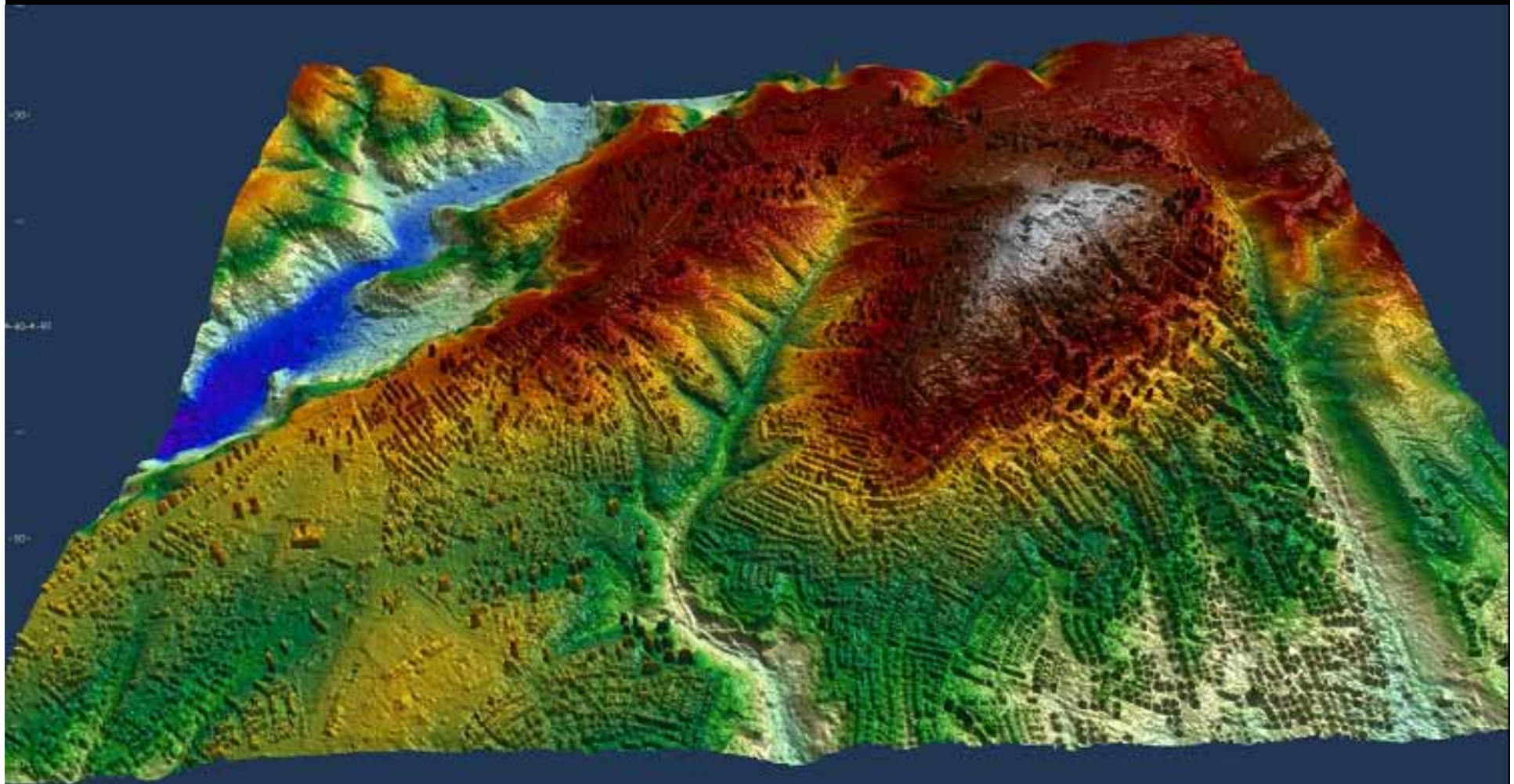


Data Provision



Ortho processing





Cartosat-2 ortho-DEM © Antrix/Euromap/DLR 5m spacing



© Geoeye/eGeos
Processed at
EuroMap/DLR
PEACE Performance
By Bob Sinclair



DLR/EUSI World-View-2 X-Band Antenna in Oberpfaffenhofen, Germany



Supporting European Coverage by VHR optical satellites

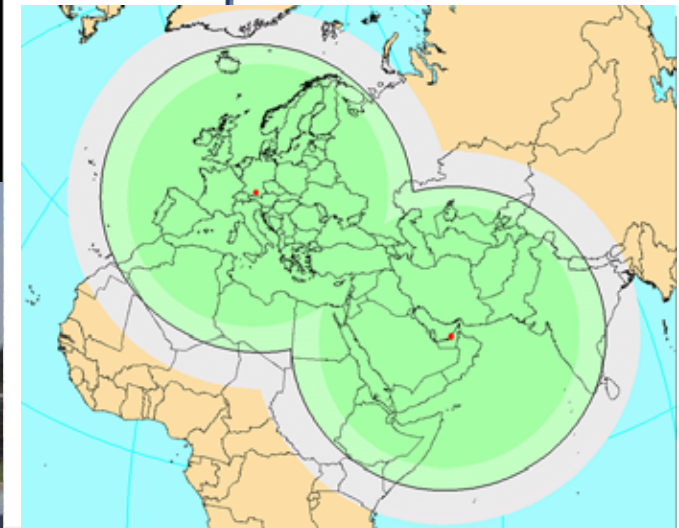
- DLR partnering with EUSI to operate the Direct Acquisition Facility (DAF) from Oberpfaffenhofen/Munich
- Continue successful partnership with EUSI & SIME

DIGITALGLOBE

EUROPEAN
SPACE
IMAGING
Visual Information. Visible Results.

SPACE
IMAGING
MIDDLE EAST

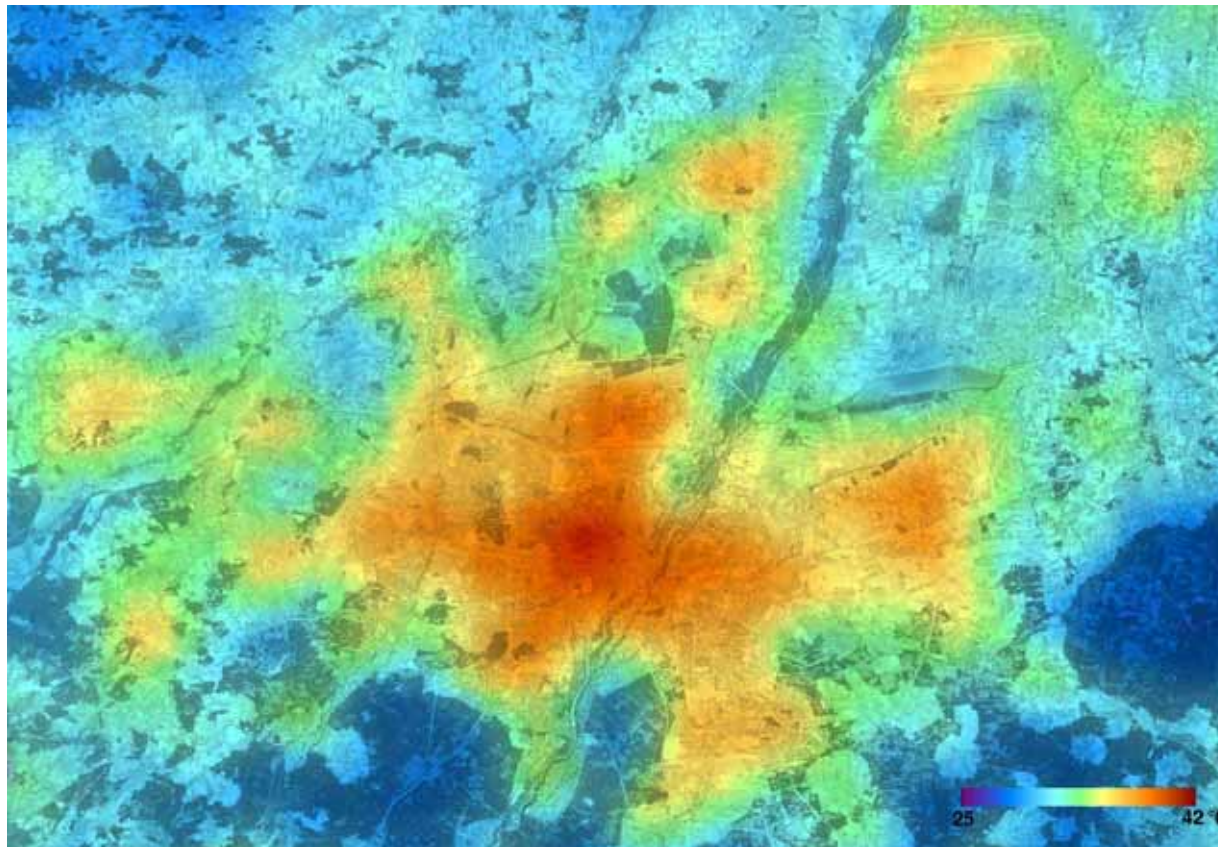
WORLDVIEW
GLOBAL ALLIANCE





European MR/ LR Coverage and Applications – DFD Oberpfaffenhofen

- data reception of Terra/Aqua MODIS, NOAA-AVHRR and Meteosat / MSG / METOP



Land surface
temperature
mapping



European MR/ LR Coverage and Applications – DFD Oberpfaffenhofen

Operational Fire Mapping (MODIS)



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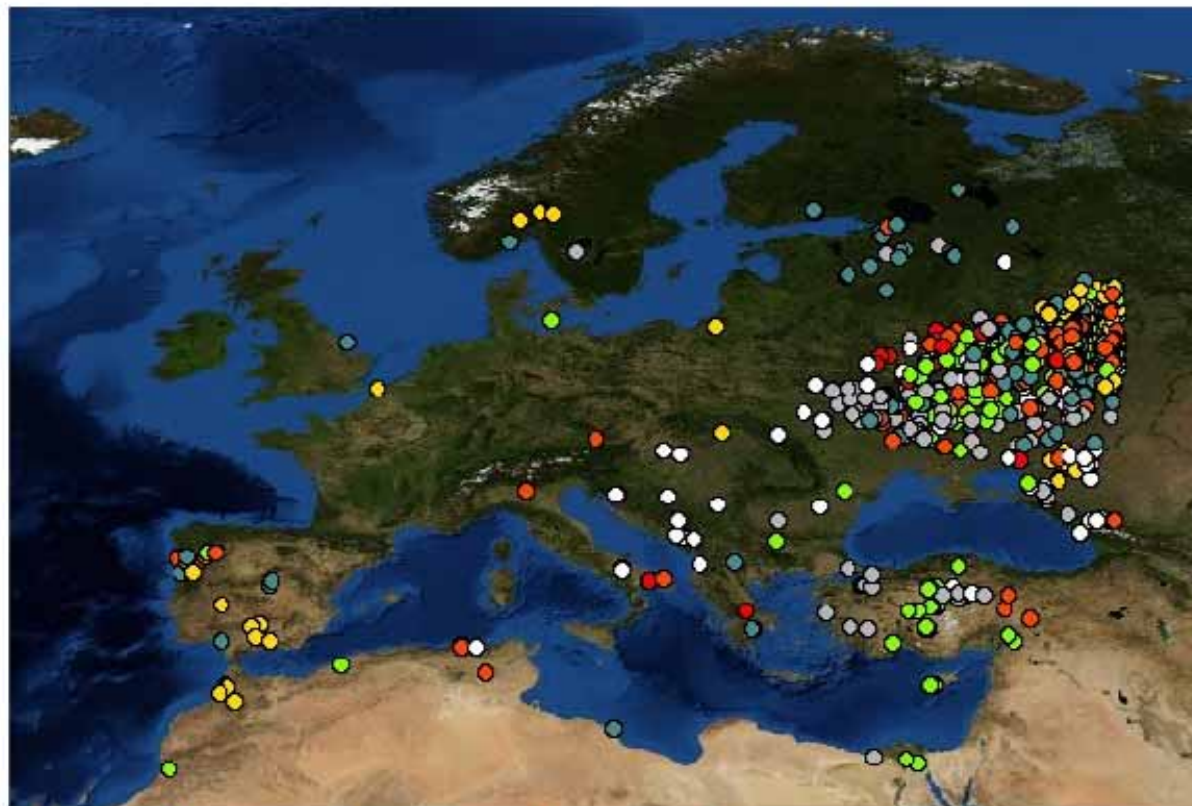
Deutsches Fernerkundungsdatenzentrum



MODIS based European Fire Service

The German Remote Sensing Data Center in the German Aerospace Center offers a new operational service on wild and forest fire detection using the NASA owned MODIS sensors on board of the Terra-1 and Aqua-1 spacecrafts.

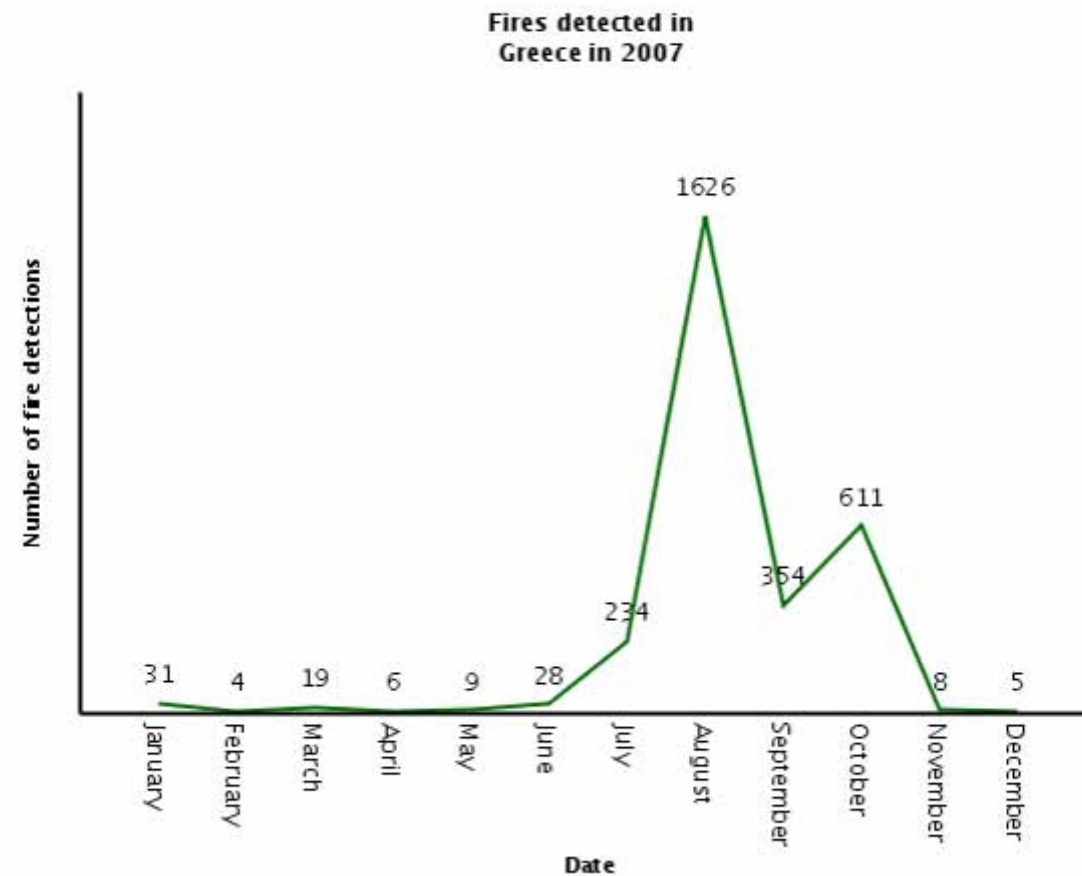
[Read the official fire service announcement.](#) [Get detailed fire service information.](#) Click [here](#) for detailed information on wild fires.

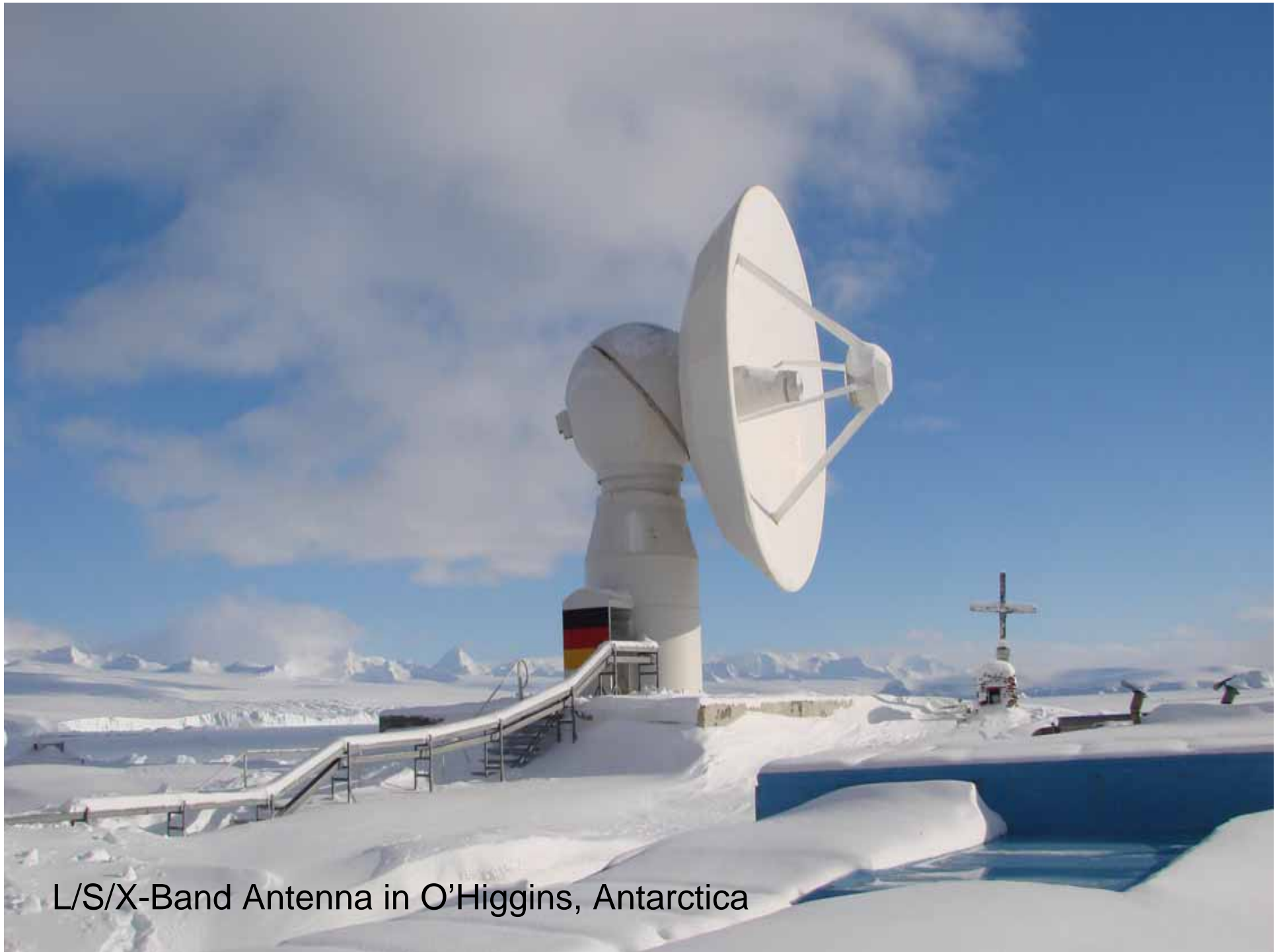


● today ● yesterday ● 2 days ago ● 3 days ago ● 4 days ago ● 5 days ago ○ 6 days ago



MODIS based European Fire Service - On-Line Fire Statistics





L/S/X-Band Antenna in O'Higgins, Antarctica

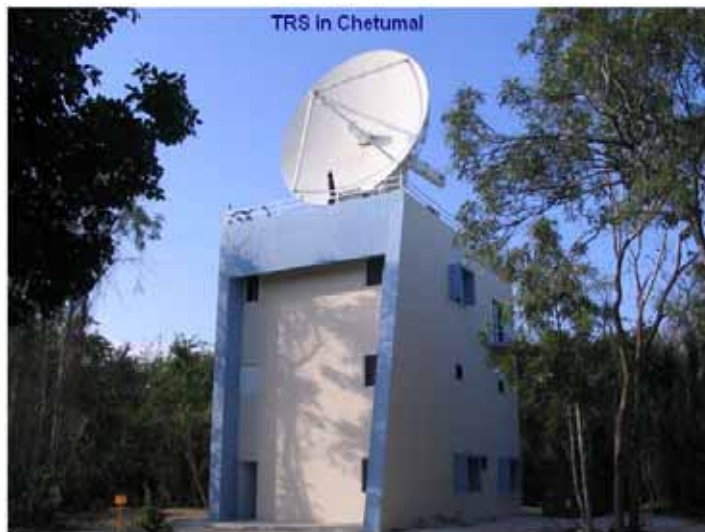




L/S/X-Band Antenna in Chetumal, Mexico

DLR Chetumal/ Mexico; ERIS

Estacion para la Reception de
Information Satelitales
Chetumal



ERS-2, Landsat 5, Terra, Aqua,
TerraSAR-X, TanDEM-X

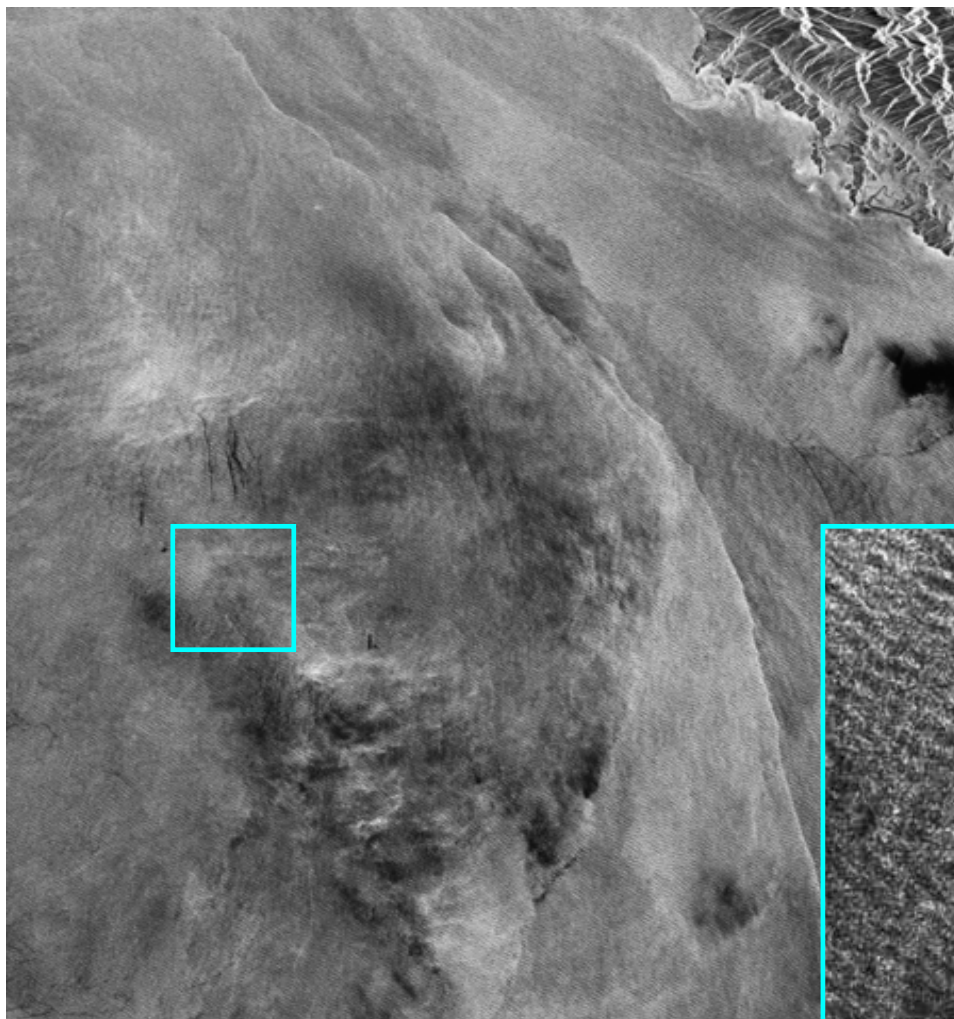
Operations aspects

- Upgrade of station control (ACU) and tracking system performed
- Equipment for TSX-1 and TDX-1 X-band downlink to be deployed and tested
- S-band capability (S-band equipment to be installed)

Application focus

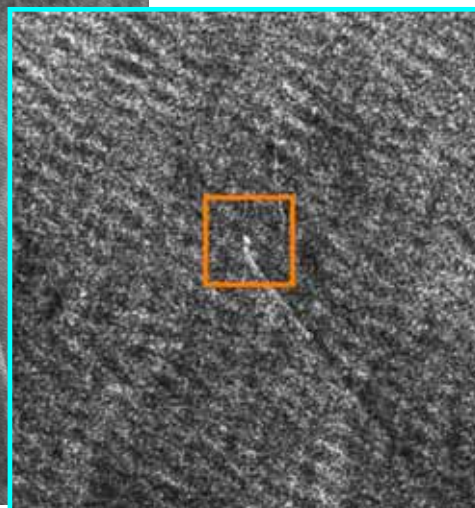
- Local Mexican applications including near real time applications for disaster management and coastal zones
- Support DLR mission dump

DLR ERIS Chetumal / Applications

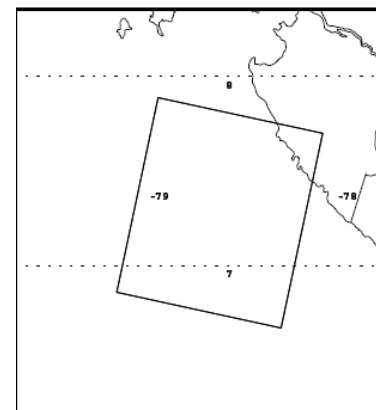
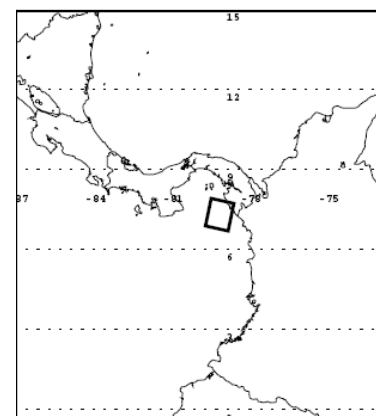


SHIP DETECTION
DLR ship detection
processor

ERS-2 acquired on
Jul 25, 2009 at
15:39 UTC
Chetumal



Spacecraft	: ERS-2
Product Type	: PRI
Product Format	: CROS format
Orbit	: 74571
Pass Direction	: Descending
Product Start Time	: 25-JUL-2009 15:39:11
Product Stop Time	: 25-JUL-2009 15:39:28
Number of Product Lines	: 9317
Pixels per Line	: 7917
Processed Input Lines	: 30304
Missing Input Lines	: 0
Doppler Centroid	: -267.473
Processing Time	: 05-AUG-2009 14:18:56
Image Location	: Colombia





L/S/X-Band Antenna in Inuvik, Canada

TanDEM-X

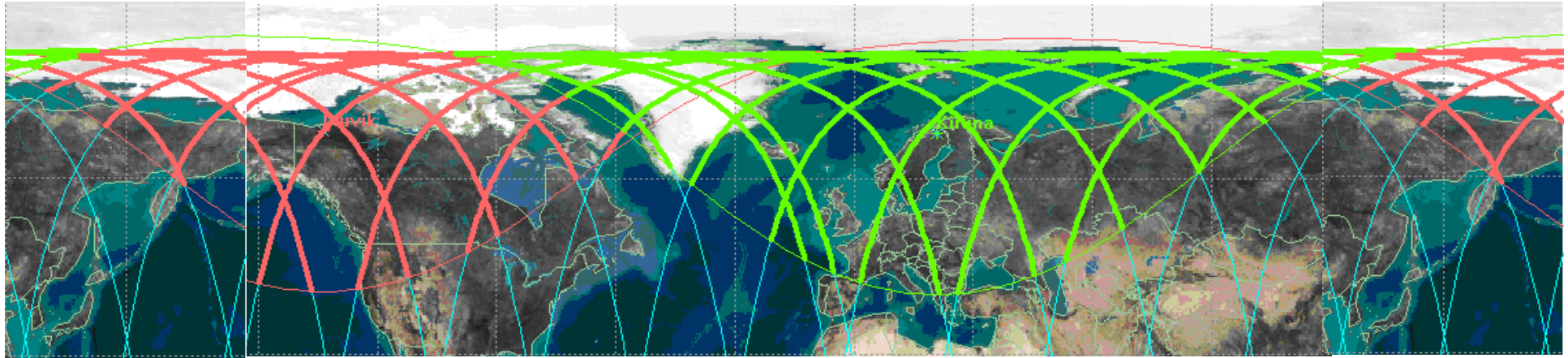
Launch June 2010

- **Global high resolution Digital Elevation Model (DEM)**
- **Innovative constellation flight**
- **Ground segment & processing by DLR**
- **PPP with Astrium/InfoTerra**





Inuvik adds to Northern European Stations





DLR Station at Inuvik Facility

68.3 N 133.7 W



New missions to be approved by
Canadian authorities

Station established in partnership with
Swedish Space Corporation, SSC
and Canada Center for Remote
Sensing, CCRS



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Operations aspects

- Set-up completed, test campaigns performed, ready for operations
- TSX-1 and TDX-1 X-band downlink redundant (high rate CORTEX HDR and MDA Direct Archive System), prepared for Sentinel downlink
- S-band downlink and uplink
- All station operation critical equipment redundant

Application focus

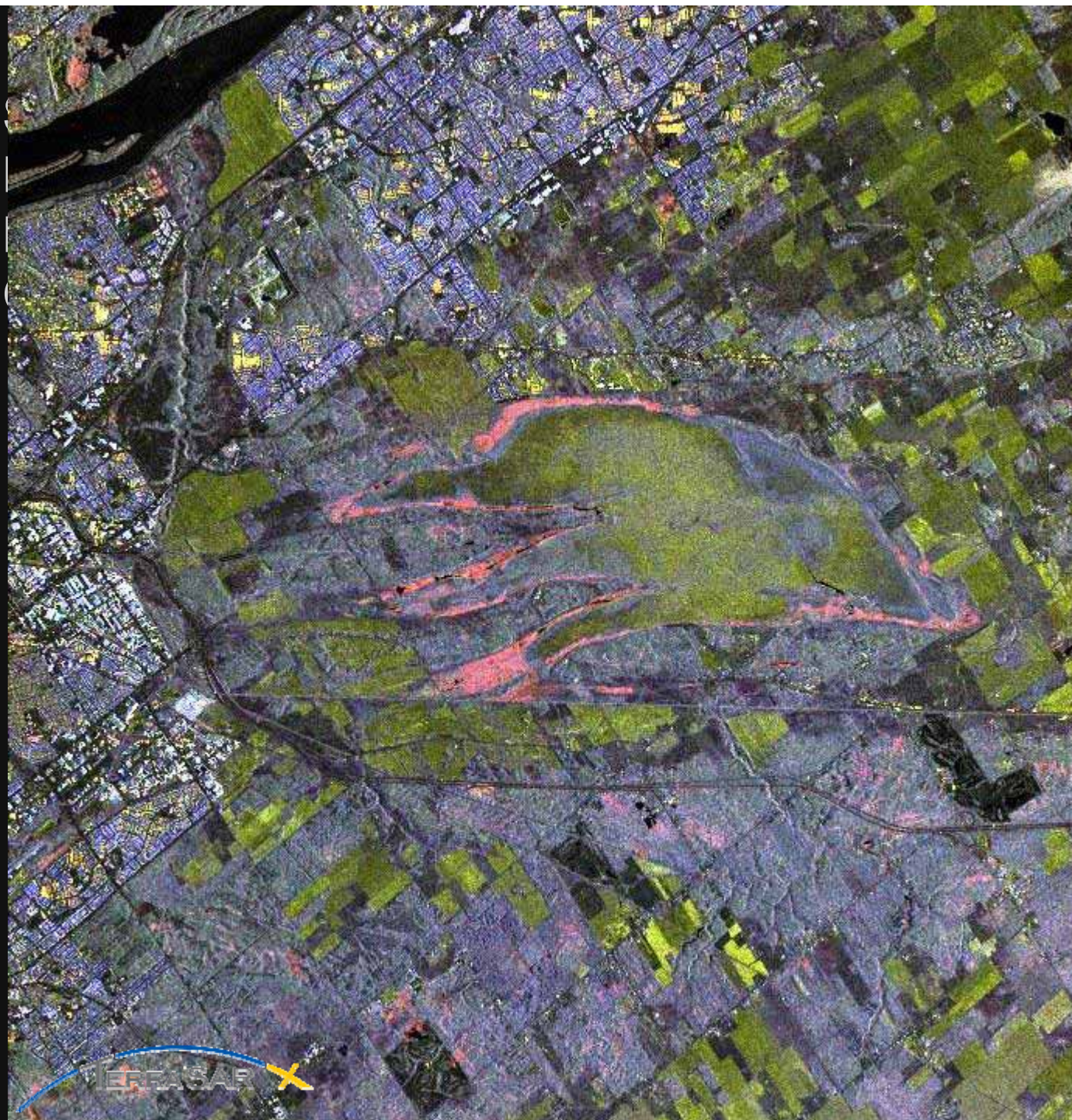
- TanDEM-X global dump
- Other missions dump support
- Arctic research applications



DLR Station at Inuvik Facility

TerraSAR-X Dual Receive Antenna Mode (mapping Inuvik)





Contributions to EO Space Segment & EO Data Supply

SAR Imaging:

SRTM

TerraSAR-X

TanDEM-X

TerraSAR-X-2 (2014), TerraSAR NT



DLR partner/
commercial distributors



Superspectral Imaging:

BIRD

RapidEye ¹⁾

IRS-P6; ResourceSAT

EnMAP (2014)



Very High resolution optical mapping:

CartoSAT-1

IKONOS, GeoEye-1 ²⁾

WorldView-1, WorldView-2 ³⁾



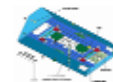
Atmospheric/Earth System monitoring

GOME

Sciamachy

Grace, Champ

MERLIN (D/F Methan Mapping Mission)



- 1) RapidEye science data distribution by DLR
- 2) Europ. Licence by Telespazio;
IKONOS operations by EUSI/DLR in OP
GeoEye-1 processing by EuroMap/DLR in NZ
- 3) Europ. Licence by EUSI; Acquisition and processing
by EUSI/DLR in OP (est. Q1/10)



***Global
Monitoring of
Environment and
Security***



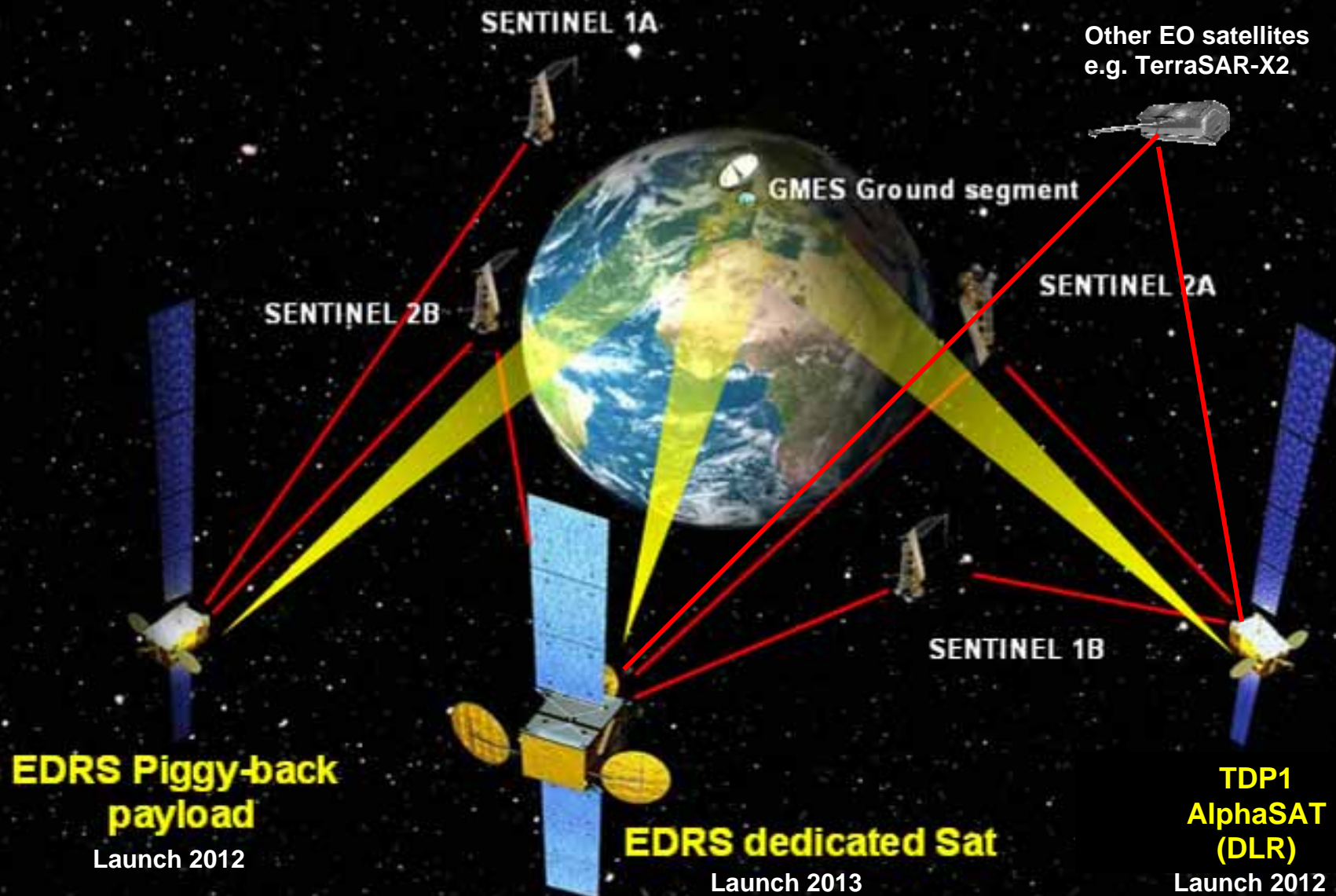
Developing GMES Core Services (FP7 & FP6)



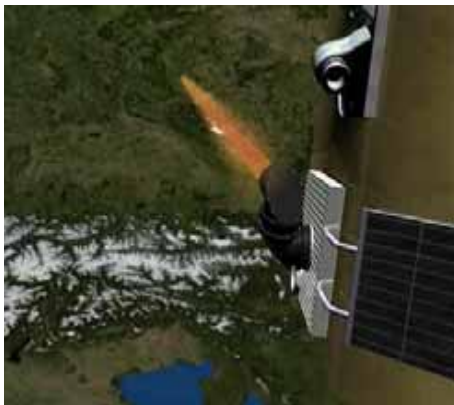
FP6 closing projects:



European Data Relay Satellites (EDRS)

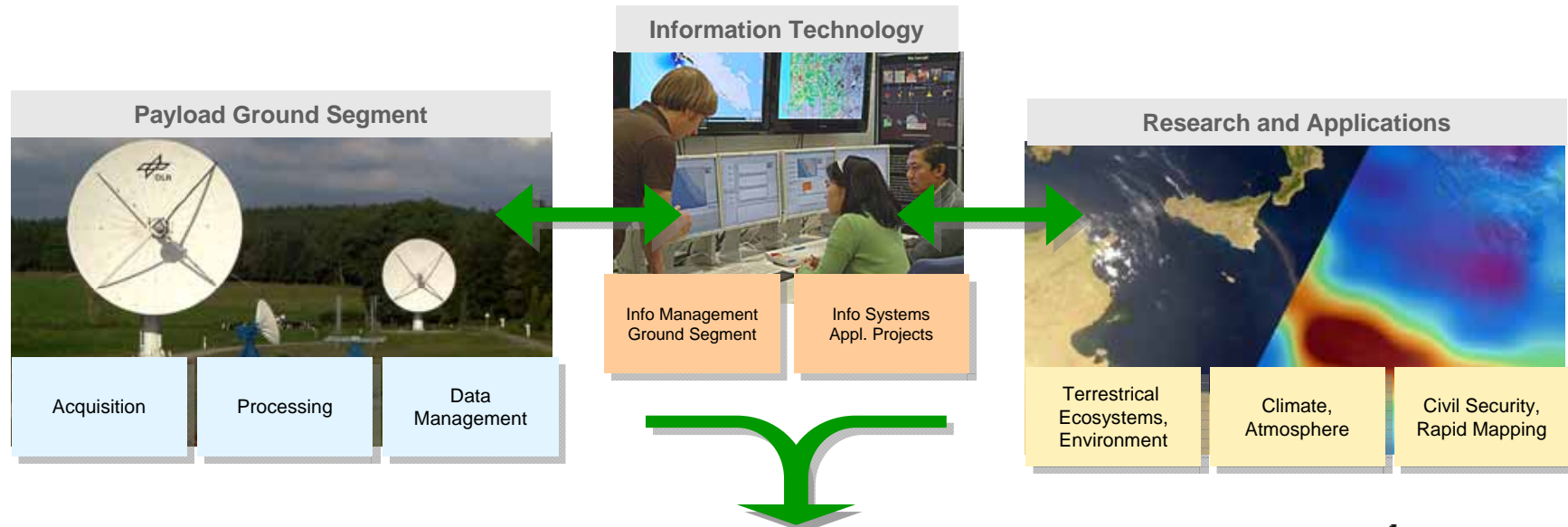


GMES Global NRT Access: LCT & EDRS

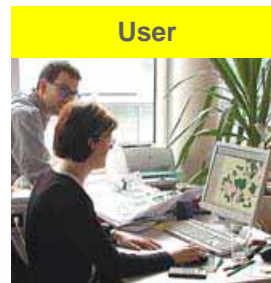


- Laser Communication Terminal (LCT)
 - Data rate up to 5,6 Gbps (BPSK)
 - Space-to-space & Space-to-ground
 - Tesat-Spacecom, Germany
- LCT on SENTINEL-1 & SENTINEL-2
- European Data Relay Satellites (EDRS) equipped with Laser Communication Terminal (LCT)
 - Ka-Band to ground
 - Ka_Band Terminals for DLR Oberpfaffenhofen & Neustrelitz under procurement/ planning

Rapid Emergency Response/ Rapid Mapping



Center for Satellite Based Crisis Information
– Emergency Mapping & Disaster Monitoring –
a service of DFD

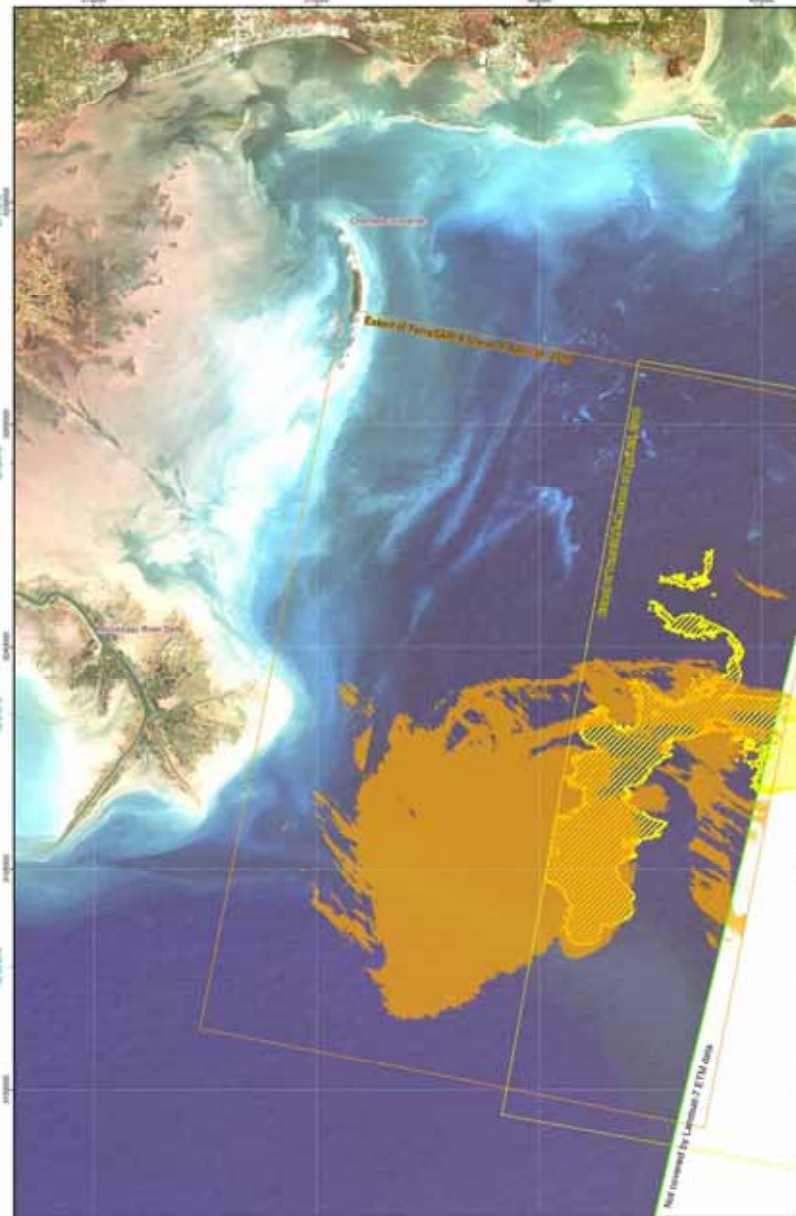


ZKI:
Zentrum für satellitenbasierte
Kriseninformation

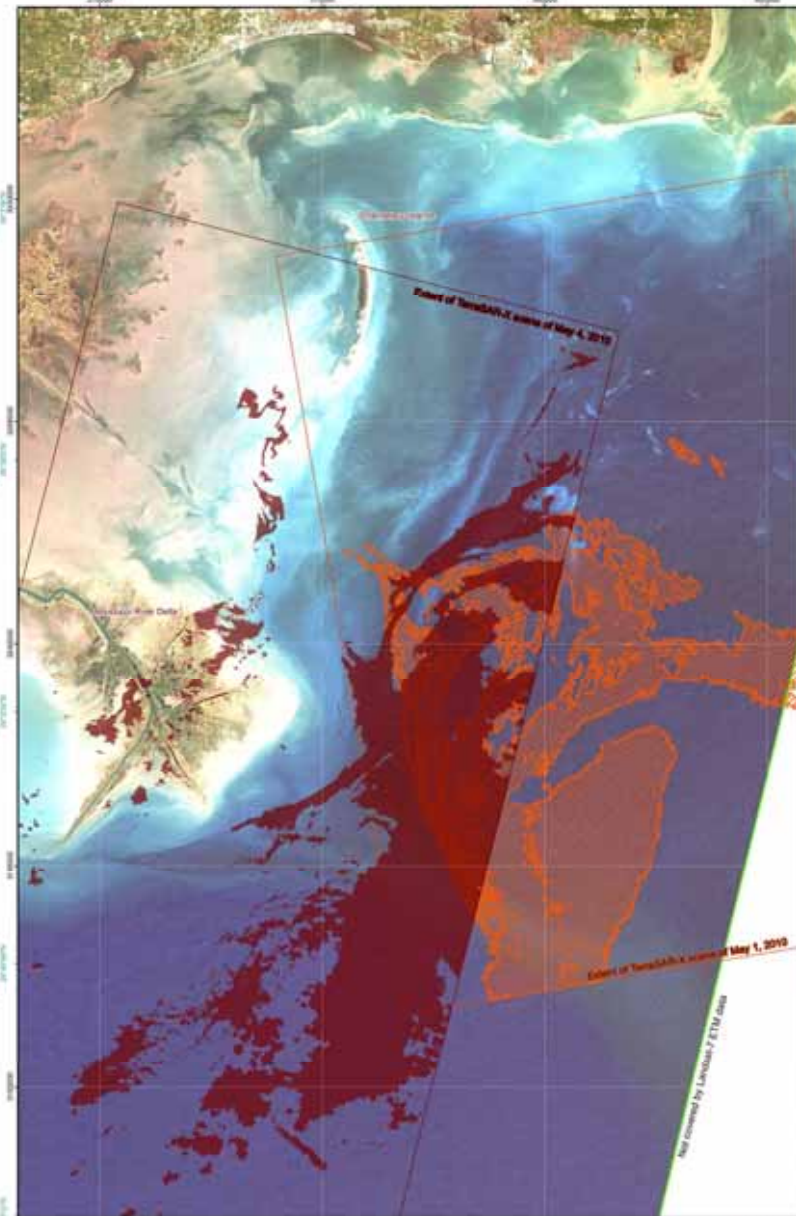


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Gulf of Mexico - Oil spill, as seen on April 25 and 30, 2010



Gulf of Mexico - Oil spill, as seen on May 1 and 4, 2010



1:500.000

Center for Satellite Based Crisis Inform
Emergency Mapping & Disaster Monitor

German Remote Sensing Data Center
German Aerospace Center

USA
Mexico
Gulf of Mexico

USA
Mexico
Gulf of Mexico

Legend

Oil spill extent

- Oil spill extent as seen on May 4, 2010
- Oil spill extent as seen on May 1, 2010
- Oil spill extent as seen on April 30, 2010
- Oil spill extent as seen on April 25, 2010

Interpretation

On April 21, 2010, the oil rig "Deepwater" caught fire after an explosion. Eleven workers missing after the incident and are presumed. On the following day, the rig sank to the sea about 1500m below the surface and approx 800 km south of the well. Every day, an estimated 800 000 liters of oil are leaking from three gashes in the well, threatening the marine ecosystem of the Gulf of Mexico and the coast of Louisiana. Efforts to stop the leakage have not been successful to date. The map shows the extent of the oil spill on April 25 and 30 and May 1 and 4, 2010, derived from automatic image analysis of TerraSAR-X (SAR mode) data. A Landsat-7 ETM scene, acquired on April 15, 2010, serves as backdrop image.

Important note: SAR data can only detect oil films of certain thickness, so the polluted area may in fact be larger than the oil extent displayed above.

Scale

0 5 10 15
kilometers

Scale: 1:500.000 for DIN A1 printing

Reference coordinate system: Geographic coord
Projection: UTM Zone 16 N
Spheroid: WGS 84
Datum: WGS 84

Data Sources

Oil spill mask: © DLR 2010
Landsat-7 ETM: © USGS 2001
TerraSAR-X: © DLR 2010
Commercial exploitation rights: reserved

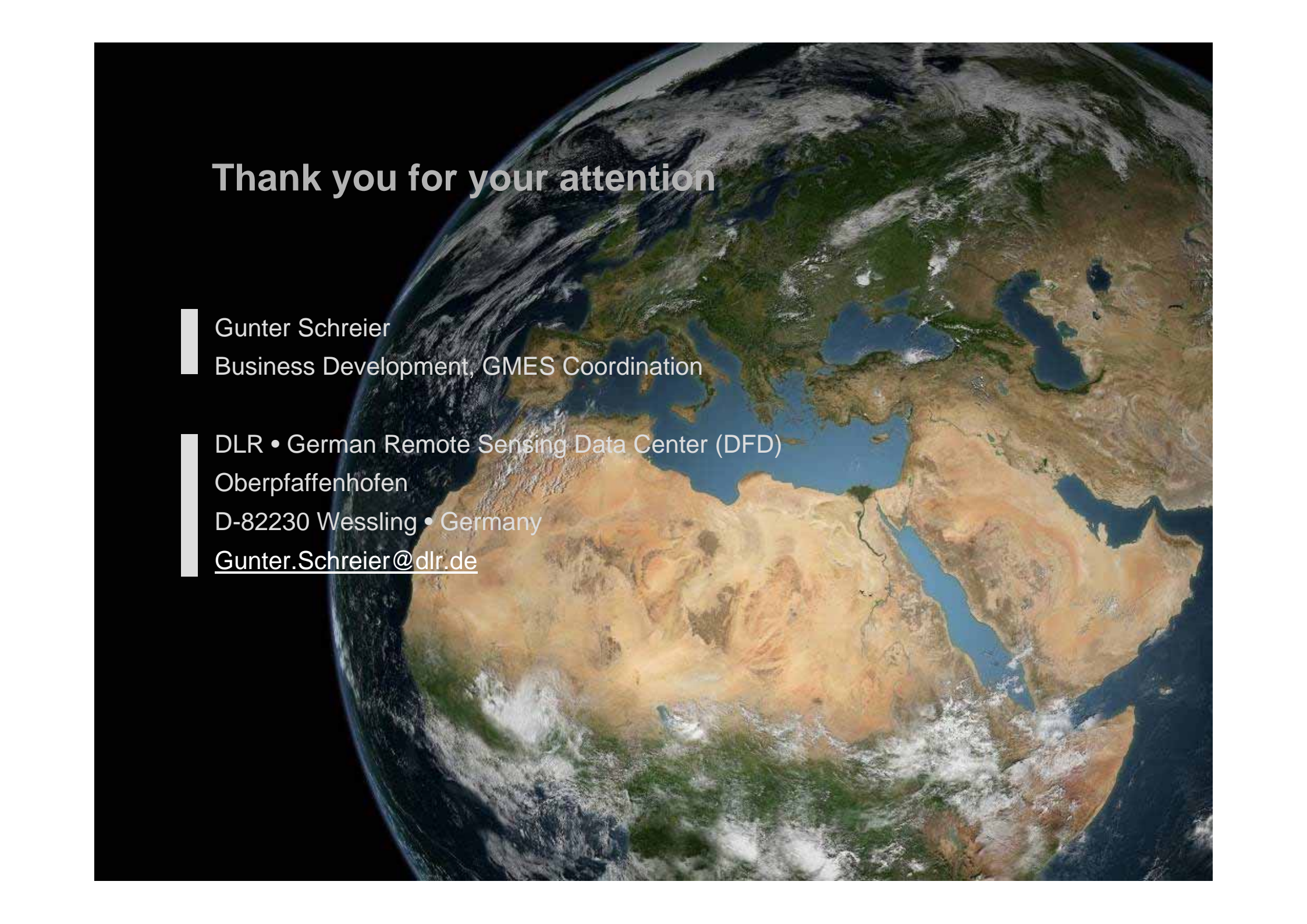
Disclaimer

The products elaborated for this Rapid Mapping Activity are realized to the best of our ability, within a very short time frame, during a crisis, optimizing the material available. All geographic information has limitations due to the scale, resolution, date and interpretation of the original source materials. No liability concerning the content or the use thereof is assumed by the producer.

Map produced May 5, 2010 by ZKI
© DLR 2010

Islands SAR

For more information visit: <http://www.zki.de>

A satellite image of Earth showing the African continent and surrounding regions. The image is oriented with the top of the frame towards the left, showing the curvature of the planet. The landmasses are in shades of brown and green, while the oceans are dark blue. White clouds are scattered across the scene.

Thank you for your attention

Gunter Schreier
Business Development, GMES Coordination

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